

**CHECKOUT AND LAUNCH CONTROL SYSTEM (CLCS)
NON-ADVOCATE REVIEW REPORT (NAR)**

Briefing to JSC Program Management Council

June 3, 1997

CLCS NAR SCHEDULE HIGHLIGHTS

- **Informal NAR task and team selection initiated April 9, 1997**
- **NAR Team Report to KSC on May 29, 1997**
- **NAR Team Report to Shuttle Program and JSC PMC on June 3, 1997**
- **NAR Report to NASA Headquarters PMC on June 20, 1997**

CLCS NAR TEAM MEMBERS

TEAM MEMBERS

Vance Brand	DFRC	Asst. Director, Flight Operations Directorate
Dennis Botkin	LARC	Program Analyst, Independent Program Assessment
Howard Eiserike	GSFC	Manager, Flt Dynamics Project Support Office
Harvey Golden	MSFC	Director, Mission Operations Laboratory
Terry Grant	ARC	Senior Engineer, Computational Sciences Division
Jack Knight	JSC	Chief, Systems Division, Mission Operations Directorate
David Lurie	NASA HQ	Program Analyst, Office of the CFO/Comptroller
David Sudduth	NASA HQ	Program Analyst, Office of Procurement

ADVISORS/TEAM SUPPORT

Darrell Bailey	MSFC	Chief, System Integration Branch, Mission Operations Laboratory
Robert Jackson	MSFC	Manager, Space Station Operations and Utilization Office
Alesha Kimbrell	DFRC	Secretary, Flight Operations Directorate
Don Shick	LARC	Program Analyst, Independent Program Assessment
Jan Justice	KSC	Secretary, Checkout and Launch Control System

PRESENTATION CONTENTS

- **CLCS Project Description**
- **Findings**
- **Summary of Recommendations**

CLCS PROJECT DESCRIPTION

CURRENT LAUNCH PROCESSING SYSTEM (LPS)

- **Used to Checkout, Control and Process Shuttle Flight Systems, Ground Support Equipment and Facilities**
- **Developed in mid-1970's and customized for Shuttle use**
- **Utilization**
 - **12 Sets of equipment in 8 control rooms in 3 locations**
 - **77,600 square feet in space**
 - **24 hour/day, 5 to 7 days/week operational use**
 - **4 vehicles in flow capability**

MISSION NEED FOR UPGRADE

- **Obsolescence of system**
 - **~ 25% of components no longer supported by vendors**
 - **~150 LRU's removed and replaced per week**
 - **Unique software language**
- **Significant cost of LPS**
 - **O&M cost ~ \$50M/Year**
 - **LPS unique training to sustain out-dated system**
 - **Costs are increasing to maintain acceptable reliability**
- **Increasingly difficult and expensive to support Shuttle upgrades**

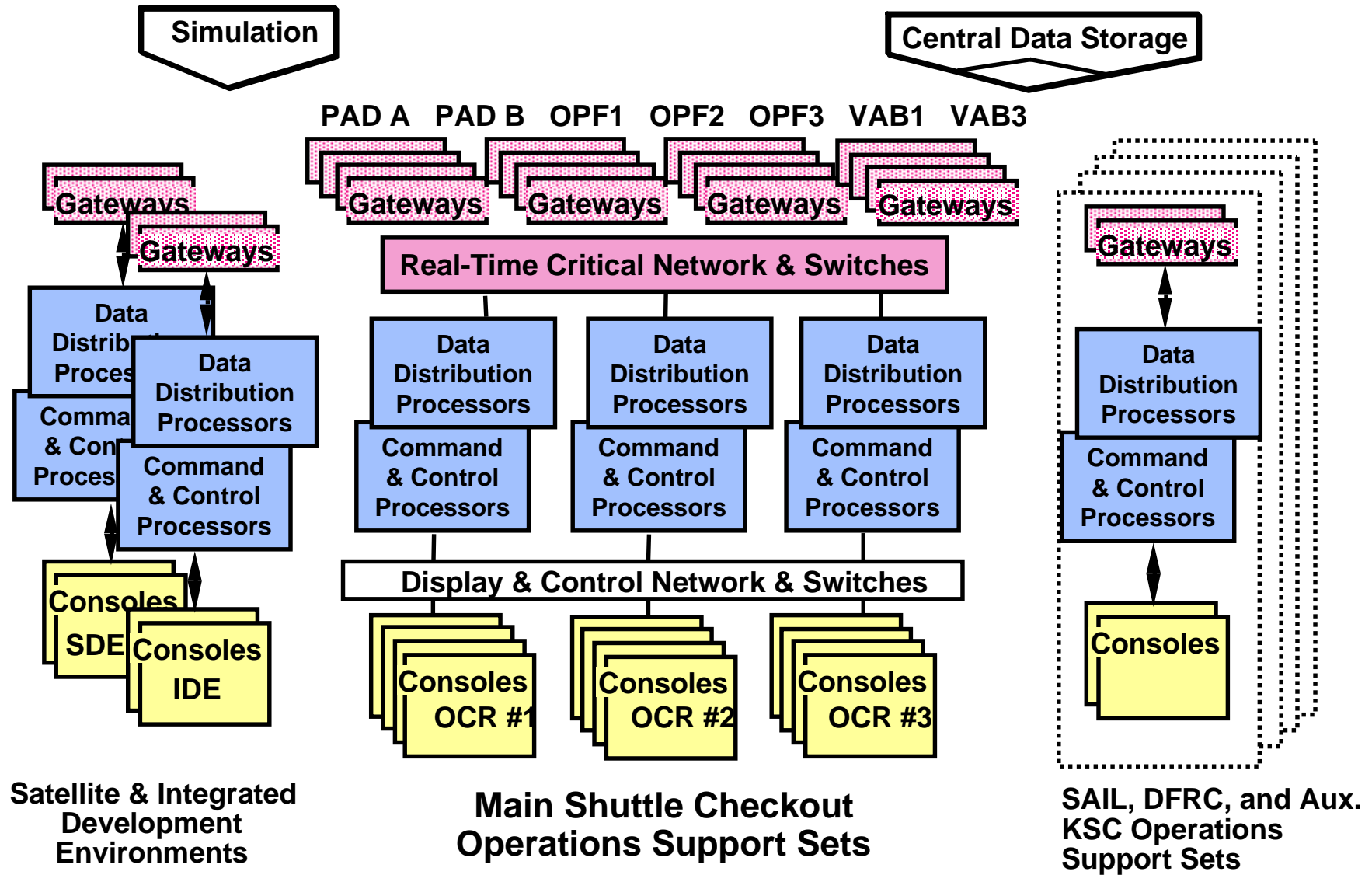
LPS UPGRADE AND NASA STRATEGIC PLAN

- **A “key assumption” of the NASA Strategic Plan: The Space Shuttle will be relied on to support NASA Missions until a new “Human Rated” launch system is developed**
- **CLCS project incorporates several of the “Critical Success Factors” as defined in the Strategic Plan for NASA’s enterprise for The Human Exploration and Development of Space:**
 - **Decrease Space Shuttle costs and improve management and operations of the integrated government/contractor team**
 - **Achieve dramatic reductions in cost of space flight**
 - **Maintain a skilled and motivated workforce**
- **“The Space Shuttle Program is committed to flying safely, meeting the manifest and reducing cost in that order of priority.”**

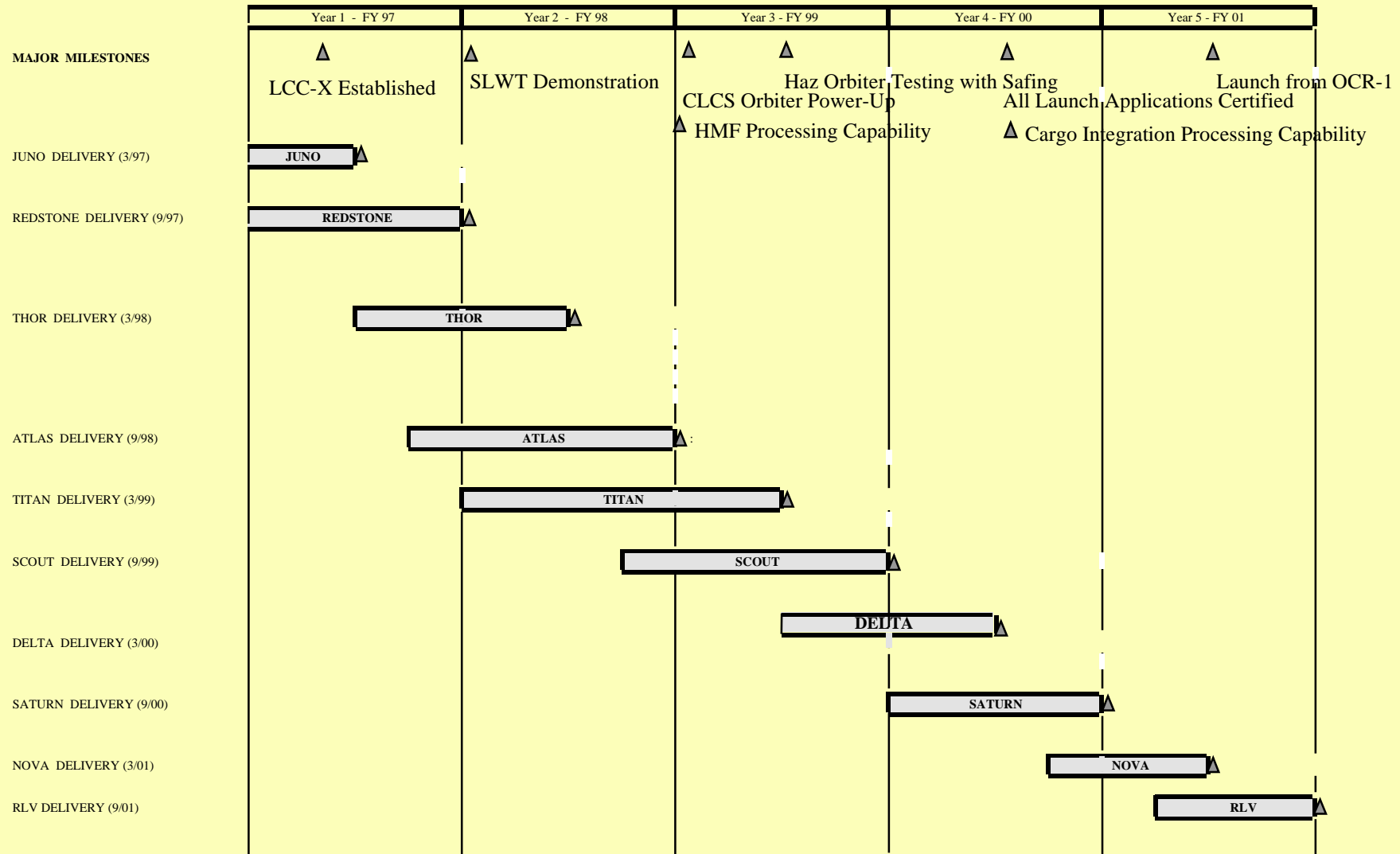
CLCS PROJECT GOALS AND COMMITMENTS

- **Modernize out-of-date system with modern commercial equipment and software**
- **Implement LPS replacement with no impact to flight hardware, flight software or the manifest**
- **Provide building blocks to support future control system requirements (e.g. potential Shuttle upgrades and RLV)**
- **Reduce operations and maintenance costs by at least 50%**
- **Reduce number of engineers required on console for daily power-up operation by at least 50%**
- **Reduce amount of paper documentation required in control rooms by at least 50%**

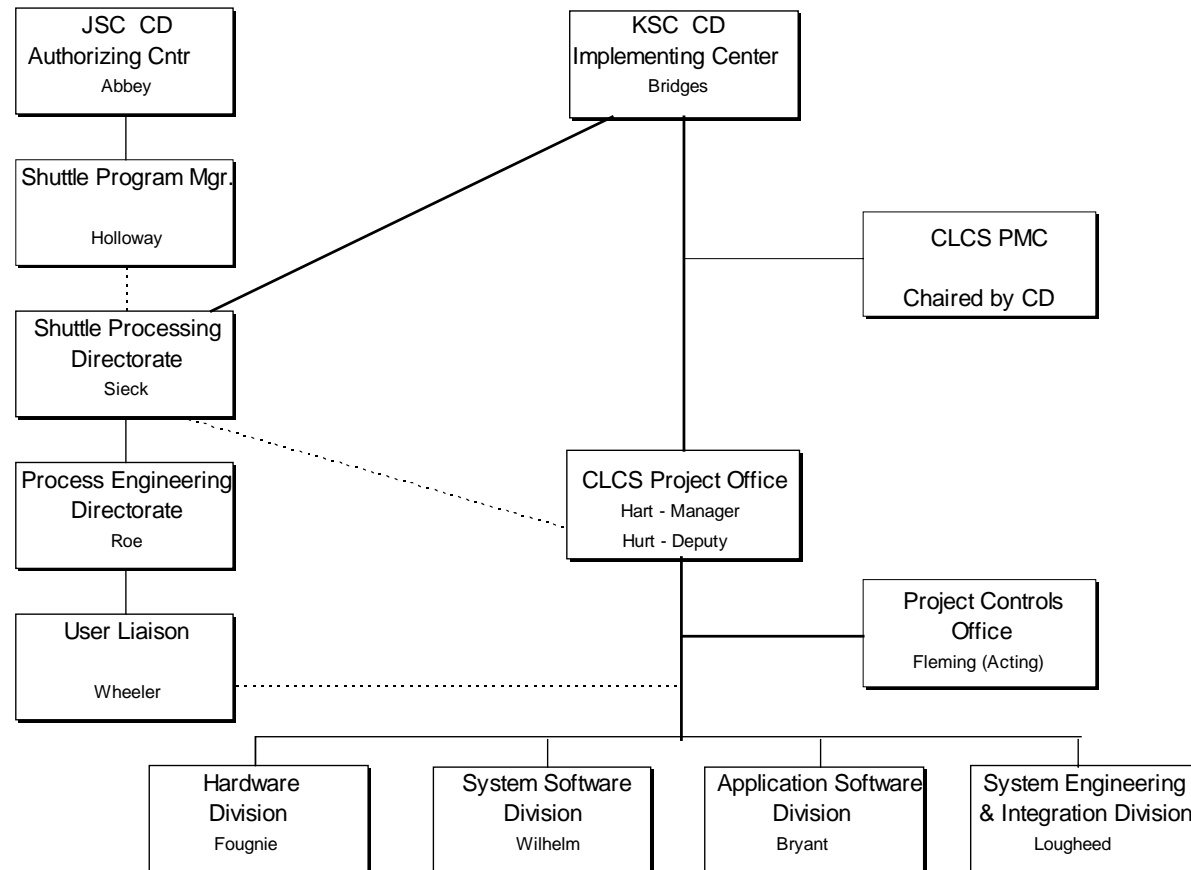
CLCS System-Level Architecture



5 Year Master Delivery Schedule



CLCS Project Management Structure



CURRENT STATUS

- **Project staffing initiated (civil service and contractor teams)**
- **Facility mods complete for experimental control room**
- **System level requirements specification in draft form and under review**
- **Incremental delivery process has been established**
- **Initial supporting contractors are identified**
 - **I-NET** **Backup engineering support**
 - **LMSMSS** **Systems software development**
 - **USA** **User requirements and applications software**
 - **MDAC** **Payloads programs**
 - **EG&G** **Applications software for facilities**

CURRENT STATUS (Cont'd)

- **First increment already delivered in March 1997**
- **Demonstrated pad weather data support and merging of Launch Pad multiple data sources; started on STS-81**
- **CLCS Architecture Baseline Review in April 1997**
- **Second increment delivery planned for September 1997**

CLCS - OVERALL

- **CLCS is needed and well thought out**
- **KSC commitment is strong**
- **Proposed technology is within the state-of-the-art and there are no showstoppers though many technical details are yet to be decided**
- **Systems architecture is reasonable and doable**
- **Cost and schedule estimates appear to be very tight; the KSC project manager should be given a reasonable reserve**
- **The project is benefiting from “CORE” and MCC upgrades lessons learned**

FINDINGS

- **Program Management**
- **Technical**
- **Schedule**
- **Cost**

PROGRAM MANAGEMENT

PROGRAM MANAGEMENT

- **Organization**
- **Project management/technical management balance**
- **Program control/management**
- **Program requirements drivers**
- **Contract management/relationship**
- **Independent verification and validation**

PROGRAM MANAGEMENT

ORGANIZATION

- **Findings**
 - **CLCS Project reports directly to KSC Center Director**
 - **Oversight is by KSC PMC**
 - **Other civil service personnel “Hard” matrixed from other Center organizations**
 - **Civil service and contractors function as IPT’s**

PROGRAM MANAGEMENT

ORGANIZATION - CIVIL SERVICE STAFFING

- **Findings**
 - **Project is currently behind in civil service staffing profile**
 - **There is steep work force “ramp” in FY97 and FY98**
- **Concern**
 - **Availability of CS Work Force with proper skills**
- **Conclusion**
 - **Needs KSC commitment to give CLCS high staffing and skill selection priority to assure enough civil service resources.
Without this, cost and /or schedule may suffer**
- **Recommendation**
 - **KSC must assure CLCS civil service staffing is a high priority for the project to succeed**

PROGRAM MANAGEMENT

ORGANIZATION -NASA/CONTRACTOR ROLE

- **Findings**
 - **NASA role is CLCS manager and system integrator**
 - **NASA leads Government/Contractor teams**
 - **Relationship of civil servants to contractors may violate prohibited personnel practices (direct supervision)**
- **Concern**
 - **Possible occurrence of prohibited personnel practices**
- **Conclusion**
 - **KSC has the necessary understanding to avoid pitfalls in this area and will seek guidance from procurement and/or legal council if in doubt**

PROGRAM MANAGEMENT

PROJECT MANAGEMENT/TECHNICAL MANAGEMENT BALANCE

- **Findings**
 - **During 60-Day Pilot Project emphasis was on technical aspects of project**
 - **Initial release of plans and processes was an outgrowth of Pilot Project**
 - **Positive transition to proper management/technical staffing ratio balance in progress**
 - **Key personnel experience base is sound**

PROGRAM MANAGEMENT

PROGRAM CONTROL/MANAGEMENT

- **Findings**
 - **Proper plans and processes are identified**
 - **Project documents are at various levels of sign off**
 - **CCB has been chartered; first meeting to be in June**
 - **CLCS team was responsive to suggestions of NAR Team**
 - **Management level metrics need clear identification**
 - **KSC support of CLCS reflected in Program Commitment Agreement (PCA) and in KSC actions to date**

PROGRAM MANAGEMENT

PROGRAM CONTROL/MANAGEMENT - PCA COMMITMENTS

- **Findings**
 - **CLCS can only enable achievement of commitments, i.e., at least 50% reduction in console engineers, at least 50% reduction on operations and maintenance costs and at least 50% reduction in control center paper**
- **Concern**
 - **USA is uneasy about joining in commitment to meet given percentage reductions**
 - **Continuing parallel management efforts are needed to achieve commitments**
- **Conclusion**
 - **Commitments require continuing high level KSC attention**
- **Recommendations**
 - **CLCS end users need to become partners in commitments**
 - **KSC needs to develop plans for parallel efforts to achieve commitments**

PROGRAM MANAGEMENT

PROGRAM REQUIREMENTS DRIVERS

- **Findings**
 - **Systems and subsystems requirements/documents are identified**
 - **Top level drivers/requirement are assumed to be the same as LPS**

PROGRAM MANAGEMENT

PROGRAM REQUIREMENTS DRIVERS - REQUIREMENTS CREEP

- **Finding**
 - Requirements document is functional /performance baseline of system
 - Requirements document is in review
 - A large number of outstanding changes/revisions currently exist against preliminary document
- **Concern**
 - There is a potential for “design creep”
- **Conclusion**
 - Timely definitization of CLCS requirements is critical
- **Recommendation**
 - Project should prioritize definitization of requirements documents and secure joint NASA and USA approval

PROGRAM MANAGEMENT

CONTRACT MANAGEMENT/RELATIONSHIPS - MULTIPLE CONTRACTOR SUPPORT

- **Findings**
 - **CLCS support is within current contracts' scope of work**
 - **There are 5 support contractors**
 - **4 of 5 contracts will be performance based/completion type**
 - **Potential exist for overlapping responsibilities between contractors**
- **Concern**
 - **Contractors will not clearly understand their obligations**
- **Recommendation**
 - **Project must develop clear, definitive task assignments and statements of work for contractor support**

PROGRAM MANAGEMENT

CONTRACT MANAGEMENT/RELATIONSHIPS - ENGINEERING SUPPORT CONTRACT

- **Findings**
 - **KSC Engineering Support Contract is small disadvantaged business (8A) type that will be completed on September 30, 1997; contract is being will be recompeted**
 - **There is high level of project dependence for backup support engineering and KSC civil servant backup from contract**
- **Concern**
 - **Contractor may not have capacity to handle evolving CLCS work requirements**
- **Conclusion**
 - **Engineering support contractor's capability to absorb high volume of work in a short time needs to be well understood. USA is another potential source of KSC civil service backup support**

PROGRAM MANAGEMENT

CONTRACT MANAGEMENT/RELATIONSHIPS - USER BUYOFF ON CLCS

- **Finding**
 - **Although CLCS users are embedded in the requirements definition process, the project has no formal process to assure acceptance by the user contractor (USA)**
 - **Government furnishes equipment as GFE to user--United Space Alliance**
 - **Joint Government/USA qualification testing done during the last 5 weeks of each delivery**
 - **User is responsible for Shuttle launches under SFOC and has \$6M fee risk per launch**
 - **User has incentive to mitigate risk--accept only “perfect” system**

PROGRAM MANAGEMENT

- **CONTRACT MANAGEMENT/RELATIONSHIPS - USER BUYOFF ON CLCS (CONT'D)**
- **Concern**
 - **Lack of formal assurance of user buyoff of final CLCS implementation. This is a critical concern**
- **Conclusion**
 - **Potential exists for conflict between NASA and USA over acceptance and operability of system (resolution may impact schedule)**
- **Recommendation**
 - **Establish formal process for user buyoff on both CLCS requirements and incremental/final implementations**
 - **Establish incentive for user to accept implementations**

PROGRAM MANAGEMENT

INDEPENDENT VERIFICATION AND VALIDATION (IV&V)

- **Findings**
 - **IV&V from NASA IV&V facility, Fairmont, WV (Intermetrics) has been proposed for CY97. Funding is being worked**
 - **Project intends to have additional IV&V of CLCS done by USA**

TECHNICAL

TECHNICAL

- **Findings**
 - **Design concept is readily capable of satisfying the CLCS objectives**
 - **Multiple configurations support complex, parallel operations and development needs**
 - **Technology is within the state-of-the-art and low risk, although many details are yet to be decided**
 - **Project benefits from lessons learned in “CORE” development experience**
 - **Console prototypes invite efficient input of user requirements**

TECHNICAL

- **Findings (cont'd)**
 - **Software development leverages MCC code and experience**
 - **Use of efficient COTS tools for software development**
 - **Creation of “reusable” software object libraries and consolidation of user requirements reduce software code**
 - **Risk mitigation includes:**
 - **tight user involvement**
 - **incremental builds**
 - **use of expert consultants**
 - **planned use of tracking metrics**

TECHNICAL

PROJECT METRICS

- **Findings**
 - Project has well defined software metrics
 - Additional metrics (i.e. hardware, system engineering) are yet to be defined
- **Concern**
 - Additional metrics needed to provide project management with clear insight into project status
- **Recommendation**
 - Identify additional metrics to capture overall project point-in-time status

SCHEDULE

SCHEDULE

SOFTWARE SCHEDULE

- **Findings**
 - Top level schedule is available
 - NAR was unable to determine schedule dependencies as they were not clearly reflected in critical path provided
 - Detailed requirements will be negotiated during each build
 - Project has little slack in software schedule
- **Concern**
 - Unplanned events and lack of detailed requirements upfront add risk to already tight schedule
 - Meeting schedule is a critical concern as it is a cost driver
- **Conclusion**
 - Risk mitigation measures are needed to compensate for tight software development schedule
- **Recommendation**
 - Define schedule critical path in greater detail
 - Continue to assess requirements in order to mitigate schedule risk

COST

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SUMMARY OF RECOMMENDATIONS

- **KSC must assure CLCS civil service staffing is a high priority for the project to succeed**
- **CLCS users need to become partners in commitments**
- **KSC needs to develop plans for parallel efforts to achieve commitments**
- **Project should prioritize definitization of requirements documents and secure joint NASA and USA approval**
- **Project must develop clear, definitive task assignments and statements of work for contractor support**
- **Establish formal method for user buyoff both on CLCS requirements and incrementally final implementation**

SUMMARY OF RECOMMENDATIONS (CONT'D)

- **Establish incentive for user to accept implementations**
- **Identify additional metrics to capture overall project point-in-time status**
- **Identify schedule critical path in greater detail**
- **Continue to assess requirements in order to mitigate schedule risk**
- **Project should program more samples of user applications now in order to narrow uncertainty in assumption of 3.3M lines of code**
- **Project reserves should be held by Project Manager**

**NAR RECOMMENDS THAT CLCS
BE GIVEN
APPROVAL TO PROCEED**